WYE COLLEGE
(University of London)

Land Requirements for the Production of Human Food

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LAND REQUIREMENTS FOR THE PRODUCTION OF HUMAN FOOD

A study of the experience of the United Kingdom during the years 1936/9 to 1949/50

By

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PREFACE

THERE is universal concern amongst responsible people about the pressure of a rising world population on the world's food resources. In arguments arising from this huge problem, the question is quickly brought up as to how much land is needed to support one human being. Only a few responsible estimates have been made and each one of these has left the impression that the area is a constant one. This report examines the question over a recent period of years and gives new information indispensable to the perennial argument "can Britain feed herself?"

Mr. James Wyllie, the past head of this Department, is an acknowledged authority on problems of farm management. Yet this report, which Mr. Wyllie has done during his retirement, deals with problems in the field of land use. It is particularly appropriate at this time because the Department of Agricultural Economics has just begun a three year research programme into the economics of land use and land competition in Britain. This is being done with the help of a grant made from United States Conditional Aid Funds.

The basic information and the argument contained in this report are vital to this new work at Wye College and to anyone else concerned with the best use of the land resources of this country.

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Head of the Department and Provincial Agricultural Economist.

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Introductory

In his book, *Food Production in War*, published in 1923, Middleton concluded that, in 1909-13, "it required three acres of cultivated land, in addition to the produce derived from mountain grazings, gardens and allotments, to maintain one inhabitant" in the United Kingdom, under the conditions of living which existed at that time. In 1926, Hall estimated that it required two to two-and-a-half acres of cultivated land to feed a man for a year according to western standards of living* and in 1942 Sir John Russell gave a figure of 1·7 acres.†

As Middleton so graphically put it, in 1914, "our farmers could have provided us with food from 10.45 p.m. on Friday, until 8 a.m. on Monday. If the product of our fisheries were added, a light supper would have been available on Friday night, so that the self-supplying régime might have begun at 9 p.m. on that day."

Middleton also concluded "that in 1909/13, some 15,440,000 persons were fed each year from our own soils whereas in the period 1831/40, the corresponding figure was 23,814,000, or, allowing for the over-dependence upon the potato crop in Ireland and in the Western Highlands and Islands of Scotland, it was about 21,500,000". He added: "However we may interpret the word 'food' there can be no question that the land of the U.K. was capable of supporting many more people at the beginning, than at the end, of the Victorian period", the chief explanation being the marked reduction in the acreage of tillage crops, especially cereals, during that period.

The first World War found this country in an extremely vulnerable position as regards food supplies. Even so, it was not until towards the close of 1916 that a Food Production Campaign was decided upon, the years 1915 and 1916 resulting in "gigantic harvests" of grain in both North and South America. Despite this late start, home food production in 1918 increased by about 24 per cent. over that in 1909/13, that is, home food supplies were sufficient for 155 days in the year against only 125 days in 1909/13.

It is not the purpose of this paper to discuss the parlous condition into which home agriculture was allowed to fall between 1919 and 1939—a period during which primary producers were complaining bitterly about "over-production" while many consumers could not get enough to eat.

When war again broke out in 1939, an elaborate Food Production Campaign had already been planned and was immediately put into operation. The relevant feature of this campaign was that the Ministry of Food was given all-embracing powers to control the movement of food products between the farmer and the consumer. Hence, much more accurate statistics of the quantities of cereals, potatoes, fat stock etc., going into consumption are available than ever before in this country. Further, since the farmer's very existence depended upon the prompt and accurate completion of the statutory censuses of crop acreages, livestock numbers, production and so on, these "production" statistics reached a level of accuracy which had not been known before. In short, the raw material, in the shape of crop acreages and outputs, which must be the basis of any reliable appraisal of the acreage required to feed an "average" inhabitant for a year, is available to an extent not hitherto known.

The acreage of land required to produce sufficient "food" to feed a "man" for a year depends on two things: first, the amount of food necessary to maintain an average "man" in a healthy condition and able to perform efficiently whatever tasks he may be called upon to do and, secondly, the yearly amount of "food" produced per acre of land.

* "The Relation Between Cultivated Area and Population": Presidential Address, British Association, Oxford, 1926.

† *The Farming Handbook*, 1942.

Calorie Requirements per Head of Population

The first step must be to reduce all the different kinds of food—bread, potatoes, green vegetables, fruit, beef, mutton, bacon, eggs and so on—to some common denominator, and it is now customary to measure the nutritive value of all foods in terms of the *Calorie*, which is the amount of heat required to raise one kilogram of water through 1° C. The justification for this method of measuring the "food" value of any diet is that only a small part of the digested food is used for purposes of growth and repair of worn out tissues; most of it is needed to supply the energy necessary for muscular and glandular action. Nevertheless, a satisfactory health-giving diet must supply not only sufficient energy but also adequate quantities of protein, fats, minerals, and vitamins, that is, the "quality" of the diet is extremely important, especially for young growing children. However, in a mixed diet, such as is provided by the "national" farm, it is reasonably safe to assume that a sufficient quantity of calories will contain all the necessary ingredients of a good diet, although, of course, it may not always be perfect.

Now the daily ration of calories to meet all requirements varies a great deal from person to person. For example, the average woman requires only about 83 per cent. as many calories as the average man, while children up to six years old require only about 50 per cent. as much. Further, whereas a sedentary worker needs only about 400 calories in excess of resting requirements—the so-called basal metabolism—a man on heavy, industrial work requires up to 2,000 calories per day extra. There is general agreement amongst nutritionists that a daily diet of 3,000 utilizable calories is sufficient for an "average" man but, because about 10 per cent. of the food escapes digestion and absorption, the daily intake should be about 3,300 calories. On the basis of a mixed population of men and women, doing many different kinds of work, and of boys and girls of different age-groups, 1,000 head can be efficiently fed on the same quantity of calories as 835 men, giving an average of 2,755 calories per head per day or 1,005,575 calories per head per annum. Since a high degree of precision cannot be claimed for this latter figure, partly because of the constantly changing make-up of the population in terms of age-groups, the physical efforts expended and so on, it is convenient to base the yearly requirements per head of population on *one million calories*.

It may be pointed out here that the question at issue is: given an efficient method of food distribution and the necessary knowledge amongst consumers of their true nutritional requirements, what acreage of land is needed to feed a given size of population? It does not follow that the actual consumption, in terms of calories, at any time corresponds exactly with the computed theoretical requirements.

Calorie Production per Acre of Crops and Grass

The second step in the solution of our problem is to determine the yearly output of calories from the home lands. As already indicated, the computation of the calorie output per acre can now be based upon the very complete and accurate statistics of the Ministries of Agriculture and Food. Whatever errors there may be in the calculation of the number of calories supplied by the different food products, it can be safely assumed that the quantities of the raw materials—wheat, potatoes, milk, beef etc.—are substantially accurate. It must be emphasized, however, that in the relevant publications of the Government Agricultural Departments* the primary object is to compute, (*a*) the gross and, (*b*) the net *monetary* output from the agriculture of the United Kingdom during the period 1939/40 to 1949/50, the average of the three years 1936/7 to 1938/9 being taken as a pre-war standard of comparison.

An example of the method of computing the yearly *gross* monetary output is given in

* Agricultural Statistics: U.K. Part II. Output etc., 1939/40-1945/6.
* Agricultural Statistics: U.K. Part II. Output etc., 1943/4 to 1949/50.

Table I. In the conversion of the outputs of the different products into calories, three problems arise.

In the first place, not all the products can be used as human food. Amongst crops, this applies to beans (for stockfeed), hay, straw, flax, linseed, hops, mustard for seed, flowers and nursery stock. The actual or estimated acreage under these crops must therefore be deducted from the total acreage in order to arrive at the acreage from which the calorie production is derived. However, no deduction has been made for straw, since the acreage of cereals is not affected by the amount of straw sold. In the case of livestock, sales of store pigs, stock pullets and cockerels to non-agricultural users have not been

TABLE I

Estimated Value of the Gross U.K. Agricultural Output: 1949/50

	Quantity (1,000 tons)	Value (£ thousand)
Crops		
Wheat	1,462	35,861
Barley	1,087	27,746
Oats	375	7,608
Rye	42	1,085
Mixed Corn	5	101
Potatoes	5,756	68,940
Sugar Beet	3,962	19,575
Beans—stock feed	1	22
Hay	334	2,794
Straw	585	1,202
Flax (as harvested)	90	1,819
Linseed	14	799
Hops	13	6,602
Mustard for seed	4	362
Fruit	763	30,246
Vegetables, except potatoes	2,157	70,644
Flowers and nursery stock	—	13,708
Total Crops	—	289,114
Livestock products		
Beef	498	84,314
Veal	26	2,157
Mutton and Lamb	142	35,825
Pig meat: not for bacon	48	9,031
Pig meat: for bacon	236	57,219
Offal	94	(*a*)
Store pigs (thousands)	116	630
Poultry: for meat	83	20,541
Poultry: for stock (thousands)	4,844	2,627
Rabbits and game	15	1,875
Milk (million gallons) (*b*)	1,955	272,443
Milk products: farm manufacture	10	2,11
Eggs	344	103,161
Wool	27	6,475
Total livestock products	—	598,411
Sundry output	—	9,651
GROSS OUTPUT	—	897,176

(*a*) Included in price of meat. (*b*) Total liquid consumption and manufacture off farms.

NOTE.—For crops, output is from the crop harvested in the first-named year, e.g. 1949 in 1949/50; for all other products output is calculated for a June to May year, e.g. June, 1949, to May, 1950.

included in the calorie computation, partly because of the great difficulty of arriving at a reasonably accurate calorie value and partly because these items are of comparatively little importance. It is true that both the pigs and the poultry will contribute in due course to the national diet, but they can quite properly be placed in the same category as the production of eggs and poultry, fruit and vegetables, rabbits etc. from holdings not over 1 acre in size ($\frac{1}{4}$ acre in Northern Ireland), cottage gardens and allotments which is not included in the gross national output. Further, although the sale of wool makes a quite substantial contribution to the gross monetary output it cannot be included in the calorie output.

Lastly, the items "sundry output" and "miscellaneous", consisting of a great variety of things such as honey and goats' milk, horses and other livestock exported, seeds, trees and shrubs exported, timber, manure, etc., sold and so on, cannot be given any calorie value, and in any case they are relatively unimportant in the gross national output.

Altogether, in 1949/50, 5·2 per cent. of the gross monetary output has been excluded from the calorie computation.

Secondly, not all the edible crops included in the gross output are actually used for human food. For example, of the gross output of 375,000 tons of the 1949 oat crop, only 264,000 tons (70·4 per cent.) were used as human food, while 102,000 tons (27·2 per cent.) were sold to non-farm users (for non-farm horses etc.) and 9,000 tons (2·4 per cent.) were sold for export. In this case, the procedure has been to calculate the acreage of oats in the gross output which was not used for human food production and then deduct this acreage from the total oat acreage. This procedure has been followed each year in the case of oats and barley in respect of that portion of the gross output not used for human food purposes. In the case of wheat only between 1 and 2 per cent. of the gross output during the war and post-war years was not used as human food and it has not been considered necessary to make any adjustment in the acreage. In the pre-war period, however, an appreciable proportion (13·2 per cent.) of the gross output was not used as human food and an adjustment in the acreage has been made. Of the gross output of potatoes, over 95 per cent. was used as human food and no adjustment in the acreage has been made, while the whole of the sugar beet output was devoted to the production of sugar for human consumption.

Calorie Value of Crops

The third, and much most difficult, problem is to determine the calorie value (per lb. or other unit) of each of the edible products given in Table I. It is perhaps not surprising that different authorities attach different calorie values to almost every product under consideration. For example, the calorie value per unit of *milk* depends on its content of butterfat and other "solids", which varies quite a lot and the *average* percentage of fat and non-fatty solids in milk must be partly a matter of opinion rather than of hard fact. This applies also to such apparently uniform products as *potatoes* and *eggs*. In the case of potatoes, however, an appreciable proportion of the gross farm output never reaches the consumer's table, because of peelings, diseased and green tubers, damaged parts, etc. Hence, the theoretical calorie value of the potato crop has been reduced by 12½ per cent.

In the case of *wheat*, yet another factor must be considered. In pre-war years, the usual "extraction" rate in flour-milling was 70 per cent., that is, 30 per cent. of the gross output of wheat was actually used as animal foodstuffs (bran, middlings, etc.) and its calorie value was realized in the form of milk and meat, eggs and poultry. The food value of wheat has been taken as 1,565 calories per lb., but to allow for a 70 per cent. extraction rate this has been reduced to 1,095 calories per lb. During the war and post-war years it varied from 73 per cent. in 1939/40 to as high as 90 per cent. in 1946 and the calorie value per lb. for each of the years 1939/40 to 1949/50, on the basis of the extraction rates, is given in the schedule of calorie values on page 10.

The conversion of the barley output into calories presents, perhaps, the most difficult problem of all, since the great bulk of it is used in brewing and distilling: on the average about 3·6 per cent. of the barley for human food was used as pearl and pot barley etc.; in 1942/3 25 per cent. was used for "flour dilution" purposes and in 1943/4 14 per cent.; but the remainder was utilized for the making of alcoholic liquor of one kind or another, the calorie value of the by-products—dried and wet grains, malt culms—being realized as milk and meat. After careful consideration of all the known factors—the calorie value of different kinds of beer and ale, the relationship between a sack of barley and a barrel of beer and so on—the calorie value of barley used for human "food" has been taken at *one-half* its theoretical value, that is, at 720 calories per lb. In a paper of this kind, it would be unfortunate if a great deal of attention became focused on the food value of alcoholic liquors and for that reason it seems best not to pursue the matter any further. It may be of interest, however, to point out that if, in 1949/50, the food value of barley had been taken as 360 calories per lb., the computed acreage required per person would have been 1·32 instead of 1·28 as given—a difference of only 3·1 per cent.

In the case of *oats*, an average of about 2 per cent. of the oats used for human food went to brewing and distilling and a very small quantity to "flour dilution", the remainder being used in the milling of various kinds of oatmeal. The food value of oatmeal has been taken as 1,800 calories per lb. and with an "extraction" rate of 60 per cent. this gives a value of 1,080 calories per lb. of oats.

Rye has been given a value of 1,200 calories and *mixed corn* 1,100 calories per lb., but these two products contribute a very small proportion of the calorie value from cereals—less than 2 per cent. in 1949/50.

The food value of *potatoes* has been taken as 350 calories per lb., that is, 400 calories less 12½ per cent. for "wastage", while *sugar beet* has been given a value of 250 calories per lb., which is based upon an average of 320 lb. of sugar per ton of sugar beet and 1,724 calories per lb. of sugar.

It is not easy to decide on the calorie value for either *fruit* or *vegetables*, because each of these items is made up of a considerable variety of products, but after careful consideration of the calorie value and relative importance of each product, fruit has been given a calorie value of 150—164 less about 10 per cent. for "wastage"—and vegetables one of 75—100 less 25 per cent. for "wastage". It need not be emphasized that these food items are important in the national diet, not so much for their calorie value as for their content of vitamins and minerals as well as for their palatability; for example, the ever-popular lettuce has a value of only 41 calories per lb. while that of tomatoes is only 54 calories per lb.

Calorie Value of Livestock Products

There is fairly general agreement about the calorie value of *milk* and of *eggs*. The former has been rated at 300 calories per lb. and the latter at 630 calories. The calorie value of *poultry meat*, *veal*, *offals* and *rabbits and game* has been put at 440, 600, 700 and 460 respectively, but no great accuracy can be claimed for any of these values. It should be remembered, however, that in 1949/50 the computed calorie value of these four products comprised only 1·2 per cent. of the total computed calorie value and in 1943/4 it was only 0·9 per cent., so that an error of even 20 per cent. would affect the total value by only about 0·2 per cent.

This leaves for consideration three important products—*beef*, *mutton* and *lamb*, and *pig meat*—and the determination of the calorie value of these products is by no means easy; first, because in each case the total output is made up of many different qualities of meat and, secondly, because the gross weight includes a substantial proportion of bone and other parts which are not edible. With such products, too, the number of complete

analyses of whole carcasses is very small indeed, and it is not surprising that the data given by different authorities are by no means in close agreement.

In the circumstances, the calorie values that are here used are somewhat arbitrary. The food value of beef has been rated at 1,250 calories per lb., of mutton and lamb at 1,400 calories and of pig meat (pork and bacon) at 1,600 calories.

For ease of reference, all these calorie values have been summarized in the schedule given below.

Schedule of Calorie Values per lb.

	Extraction rate	C.V. per lb. of output
Wheat		
Pre-war	70	1,095
1939/40	73	1,142
1940/1	73	1,142
1941/2	85	1,330
1942/3	85	1,330
1943/4	85	1,330
1944/5	81	1,268
1945/6	82	1,283
1946/7	87	1,362
1947/8	85	1,330
1948/9	85	1,330
1949/50	85	1,330
Barley		720
Oats		1,080
Rye		1,200
Mixed Corn		1,100
Potatoes		350
Sugar beet		250
Fruit		150
Vegetables		75
Milk		300
Eggs		630
Beef		1,250
Veal		600
Mutton and lamb		1,400
Pig meat		1,600
Offal—all		700
Poultry meat		440
Rabbits and game		460

The detailed computation of the yearly calorie output in the U.K. for the war and post-war years is given in the Appendix, Tables A to L; and, to complete the foundation of hard facts, Table M gives a brief summary of the land utilization and Table N of the numbers of the different classes of livestock for each of the years during the period 1939/40 to 1949/50, the averages for the three years 1936/7 to 1938/9 being taken as a pre-war standard. The next step is to translate these tables into terms which can be comprehended by the ordinary reader.

Sources of Calorie Output

In the first place, the marked changes that have taken place in our home food supplies can be shown, regardless of calories, by summarizing the quantities of the various food products available each year during the period. This is done in Table II.

It will be seen that it was not until 1941/2 that the results of the increased food production campaign began to be clearly shown. In that year, the acreage of tillage land increased to 12·7 million acres, against 8·9 million acres in 1936/9, the number of sheep decreased from 26·4 million to 22·3 million, of pigs from 4·4 million to 2·6 million, and of

poultry from 78·2 million to 62·1 million, while on the other hand the number of dairy cattle increased from 3·8 million to 4 million (Tables M and N, app.). It is, therefore, not surprising to see a substantial increase in the production of cereals, potatoes and sugar beet, coupled with a considerable reduction in the output of meat and eggs. There was also a reduction in the output of milk, due principally to the much restricted quantities of imported cakes and meals that were available, as well as to the fact that it was some time before milk producers were able to adjust their cropping to the requirements of the dairy herds.

TABLE II

Principal Sources of Calorie Production in U.K.

Year	Cereals	Potatoes	Sugar beet	Fruit and vegetables	Milk	Eggs	Meat
	1,000 tons	*1,000 tons*	*1,000 tons*	*1,000 tons*	*mill. gals.*	*1,000 tons*	*1,000 tons*
1936/9	1,379	3,191	2,741	2,415	1,563	304	1,413
1939/40	1,426	3,224	3,529	2,813	1,550	308	1,397
1940/1	1,771	3,766	3,176	2,695	1,446	291	1,359
1941/2	2,582	4,333	3,226	2,728	1,417	218	917
1942/3	3,604	4,934	3,924	3,478	1,522	165	961
1943/4	4,292	6,094	3,760	3,288	1,580	160	919
1944/5	3,599	6,061	3,267	3,488	1,594	169	943
1945/6	2,927	6,309	3,886	3,379	1,654	195	995
1946/7	2,612	6,623	4,522	3,381	1,665	198	958
1947/8	2,322	5,225	2,960	3,346	1,704	223	845
1948/9	2,999	6,263	4,319	3,369	1,909	279	983
1949/50	2,727	5,756	3,962	2,920	2,011	344	1,142

Secondly, although the output of *milk* increased steadily from 1,417 million gallons in 1941/2 to 2,011 million gallons in 1949/50, partly because of a steady increase in the number of cows and partly owing to higher average yields per cow,* the quantities of cereals, potatoes and sugar beet fluctuated considerably from year to year, partly because of variations in the acreages grown and partly owing to variations in the annual yields per acre.

The area under *cereals* increased from 5,305,000 acres in 1939 to a maximum of 9,560,000 acres in 1943, that is, by 80 per cent. and then fell to 8,020,000 acres in 1949. Since about 66 per cent. of the computed calories from cereals was derived from wheat, the increase in the area under wheat from 1,766,000 acres in 1939 to 3,464,000 acres in 1943, followed by a decline to only 1,963,000 acres in 1949, is of particular importance. The area under *potatoes* was 704,000 in 1939, increased to 1,417,000 acres in 1944, 1,548,000 acres in 1948, and then fell to 1,308,000 acres in 1949; while the area under *sugar beet* was 344,000 acres in 1939, 431,000 acres in 1944, 395,000 acres in 1947, and 421,000 acres in 1949. The causes of these fluctuations in crop acreages were, of course, partly fortuitous, because of seasonal conditions, but they were, no doubt, mainly due to farmers' reactions to the current price policy. Table M (app.) shows that the total area under tillage crops increased from 8·8 million acres in 1939 to a maximum of 14·6 million acres in 1944, and then fell to 12·7 million acres in 1949 while the area under temporary grasses fell from 4·1 million acres in 1939 to 3·6 million acres in 1941, and then rose

* The average gross yield per cow for the U.K. was officially estimated at 542 gallons in pre-war years; it fell to only 459 gallons in 1941/2 and then rose steadily to 581 gallons in 1949/50.

steadily to 5·7 million acres in 1949. Meanwhile, the area under permanent grass declined from 18·8 million acres in 1939 to 12·7 million acres in 1949.

As regards *crop yields*, the position can be summarized thus:

	Highest yield *per acre*	*Year*	Lowest yield *per acre*	*Year*
Wheat	22·5 cwt.	1949	15·4 cwt.	1947
Barley	20·7 cwt.	1949	15·5 cwt.	1941
Potatoes ..	7·7 tons	1940	5·8 tons	1947
Sugar beet ..	10·5 tons	1946 / 1948	7·6 tons	1947

The year 1947 stands out as one of uniformly poor yields per acre while in 1949 the yields were good to very good. It is clear that even with the same acreages the total crop outputs would still fluctuate considerably.

The variations in the acreage under *fruit and vegetables* are of little significance because only about 3 per cent. of the total calories was derived from these crops.

The output of *eggs* fell from 308,000 tons in 1939/40 to only 160,000 tons in 1943/4 and then rose steadily to 344,000 tons in 1949/50, these fluctuations being in line with the variations in the number of poultry (Table N, app.). Lastly, the output of *meat* of all kinds fell from 1,397,000 tons in 1939/40 to only 919,000 tons in 1943/4 and then increased, rather erratically, to 1,142,000 tons in 1949/50. It is worth noticing that in all the cases quoted, *except meat*, the output in 1949/50 was substantially higher than it was in 1939/40. In the case of meat, it was still 270,000 tons lower.

Percentage Composition of Calorie Output

Tables A to L in the appendix give the percentage of the total yearly output which was derived from each separate product and Table III summarizes these percentages under the principal product headings.

Table III

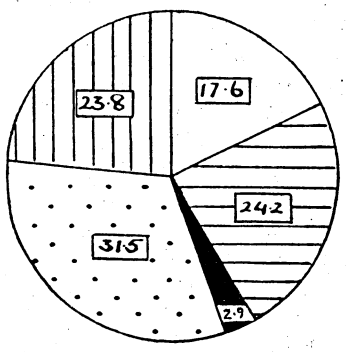
Percentage Composition of Calorie Output in U.K.

Year	Crops				Livestock			Total
	Cereals	Potatoes and sugar beet	Fruit and vegetables	Total	Milk and eggs	Meat	Total	
1936/9 ..	17·6	24·2	2·9	44·7	31·5	23·8	55·3	100·0
1939/40..	17·7	26·0	3·5	47·2	30·2	22·6	52·8	100·0
1940/1	21·6	26·5	3·1	51·2	27·4	21·4	48·8	100·0
1941/2 ..	33·4	26·9	2·6	62·9	24·3	12·8	37·1	100·0
1942/3 ..	38·3	26·2	3·1	67·6	21·2	11·2	32·4	100·0
1943/4 ..	42·5	26·2	2·5	71·2	19·4	9·4	28·8	100·0
1944/5 ..	37·2	27·6	2·9	67·7	21·7	10·6	32·3	100·0
1945/6	30·3	31·4	2·9	64·6	23·7	11·7	35·4	100·0
1946/7 ..	28·3	33·8	3·0	65·1	23·8	11·1	34·9	100·0
1947/8 ..	27·3	29·4	3·6	60·3	28·5	11·2	39·7	100·0
1948/9 ..	30·2	30·2	2·8	63·2	26·0	10·8	36·8	100·0
1949/50	27·9	28·2	2·6	58·7	28·1	13·2	41·3	100·0

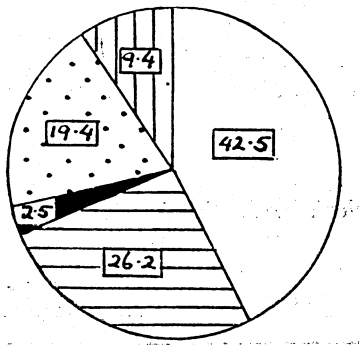
See also Diagram I.

DIAGRAM 1. Percentage Composition of Calorie Output in the United Kingdom.

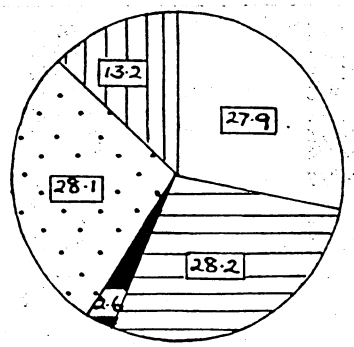
1936/39. . . .



1943/44. . . .



1949/50. . . .



KEY.

Cereals.

Potatoes & Sugar Beet.

Fruit & Vegetables.

Milk & Eggs.

Meat.

SOURCE: Table III.

The outstanding feature of this Table is the relative importance of crops and livestock as a source of human food, measured in calories. In 1939/40, *crops* contributed about 47 and *livestock* about 53 per cent. of the total, whereas in 1943/4 the corresponding figures were 71 and 29. By 1949/50, however, the contribution of livestock had risen to 41 and that of crops had fallen to 59 per cent. The contribution by *cereals* varied from only about 18 per cent. in 1939/40 to fully 42 per cent. in 1943/4, whereas *potatoes* and *sugar beet* never contributed less than 26 per cent. (1939/40) or more than 34 per cent. (1946/7). The contribution by *fruit* and *vegetables*, other than potatoes, averaged only about 3 per cent.—from 2·6 in 1941/2 to 3·6 per cent. in 1947/8.

The percentage of calories from *milk* and *eggs* ranged from 19·4 in 1943/4 to 30·2 in 1939/40, of which eggs contributed only about 1½ per cent. on the average. Lastly, and in some ways most important of all, only about 9½ per cent. of the calorie output was derived from *meat* of all kinds in 1943/4, compared with 22½ per cent. in 1939/40 and no more than about 13 per cent. in 1949/50.

These percentage figures must not be misunderstood. For example, the percentage from milk and eggs fell from 28·5 in 1947/8 to 26 in 1948/9, not because of a decrease in the total output of milk and eggs, but because the rate of increase in the output of these products was less than it was for cereals, potatoes, sugar beet and meat (Table II).

Calorie Production and Number of Persons Fed per Acre

Table IV summarizes the answers to the two vitally important questions: first, what acreage of land is required to feed an "average" person for a year and, second, what is the total number of persons fed on the produce of U.K. soils, assuming a yearly consumption of one million calories per average person?

Table IV

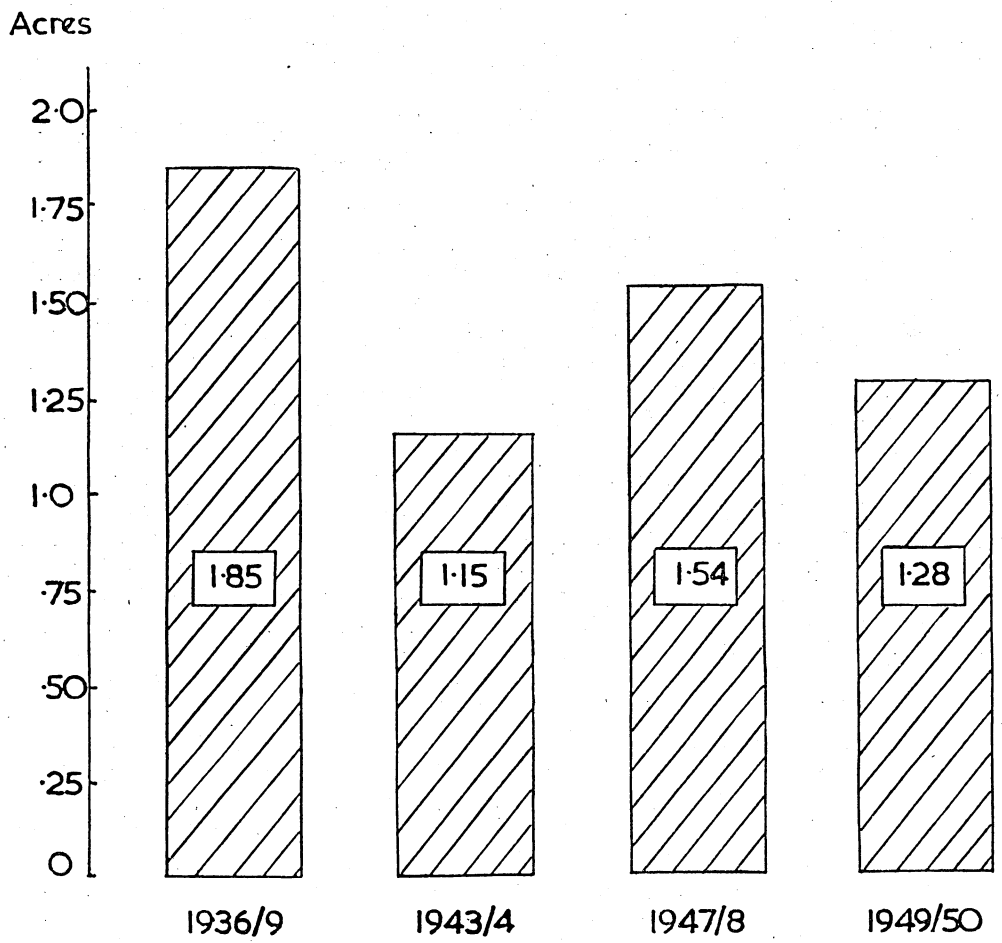
Calorie Production per Acre and Number of Persons Fed in U.K. from Home Production

Year	Calories produced per acre	Acreage to feed one person	Persons fed per 100 acres	Total number of persons fed (thousands)
1936/9	540,617	1·85	54·1	16,687
1939/40	560,760	1·78	56·1	17,324
1940/1	582,523	1·72	58·3	17,828
1941/2	633,274	1·58	63·3	19,321
1942/3	763,091	1·31	76·3	23,167
1943/4	867,325	1·15	86·7	26,285
1944/5	788,177	1·27	78·8	23,849
1945/6	754,696	1·33	75·5	22,712
1946/7	754,107	1·33	75·4	22,826
1947/8	646,783	1·54	64·7	19,579
1948/9	796,270	1·26	79·6	24,224
1949/50	784,035	1·28	78·4	23,845

See also Diagram II.

As to the yearly acreage per person, it would appear that in pre-war years the amount was about 1·8 acres. In the first two years of the war there was only a slight reduction, but by 1941/2 only about 1·6 acres were required. In 1943/4, production of calories was at its maximum and the average person was fed off only 1·15 acres; in 1947/8, 1·54 acres were necessary to feed an average person, but in 1948/9 and 1949/50, the acreage was only about 1·3.

DIAGRAM II. Acreage Required to Feed One Person.



SOURCE : Table IV.

Table IV also shows that in pre-war years, the land of the U.K. provided enough food for a population of about 16½ million; in the first two years of the war, the figure rose to about 17¾ million, it moved rapidly up to a maximum of about 26¼ million in 1943/4 and then settled around 23 million, except in 1947/8 when it fell to only 19½ million. Taking the six years 1944/5 to 1949/50 as a long enough period to even out seasonal fluctuations, it would appear that on the average of these years 1·33 acres were sufficient to produce enough food for an average person for a year, equivalent to a population of about 22¾ million, against only about 16½ million in 1936/9—an increase of fully 37 per cent. In so far as a high proportion of calories from animal products is associated with high "quality" in the diet, Table III shows that the quality deteriorated during the war years and then improved appreciably up to 1949/50.

It is unfortunate that comparable data for the years subsequent to 1949/50 are not yet available, as it would be of great interest to discover whether the performance of the years 1944/5 to 1949/50 has been maintained or even bettered.

Accuracy of Data

Before going further with the discussion, it may be well to answer the question: just how reliable are these final computations of acreage per person and total number of persons fed each year?

Broadly speaking, the chief source of possible errors lies in the conversion of the quantities of the various food products into calories. In the case of wheat, oats, potatoes, sugar beet, milk and eggs it is unlikely that the conversion error is of any real significance: it must be remembered that the probable error in the total calories from these products is likely to be less than for any single one of them since errors in the conversion of individual products are likely to cancel one another out. The important point here is that, on the average, the calories derived from these six products make up 76 per cent. of the total calorie output—from 68 per cent. in 1939/40 to 81 per cent. in 1943/4.

In the case of barley, rye, mixed corn, fruit and vegetables (other than potatoes) and all kinds of meat, there is more uncertainty about the accuracy of the conversion factors that have been used but it should be kept in mind that an error of even 10 per cent. in the conversion of these products would affect the final computations by only about 2½ per cent. on the average. In other words, *it is unlikely that the probable error* in the final figures of acreage per person, and therefore of the yearly number of persons which could be fed from the produce of the home lands, *is more than about 2 per cent.*—a margin of error which is always permissible in calculations of this kind.

On the other hand, in so far as the object of these computations is to indicate the *trend* of calorie production during the war and post-war years, it is unlikely that the probable error in the calculations differs appreciably from year to year. There is in fact little doubt that Table IV gives a completely reliable indication of the *comparative* yearly output of calories in the U.K. during the period 1936/9 to 1949/50, of the yearly acreage to feed an average person and of the yearly number of persons which were fed from the home lands.

Even so, one slight qualification must be made to that conclusion. As already pointed out, in the years 1939/40 to 1941/2 there was a substantial reduction in the numbers of sheep, pigs and poultry (Table N, app.), and this meant that some part of the output of these years was obtained by the realization of capital stocks; for example, gilts were fattened which would ordinarily have been kept for breeding, and similarly for gimmers (ewe tegs).

It might also be contended that in the years 1939/40 to 1942/3, part of the output was derived from the "cashing in" on the accumulated fertility of the permanent pastures that were ploughed up. This may be true of the better class permanent grassland but the chief weakness of the bulk of this land was its poverty stricken condition.

It is important to notice, however, that neither of these qualifications has much relevance to the year 1943/4 when maximum calorie output was reached, or to the years 1944/5 to 1949/50 for which average results have been given on page 16.

INDEX OF CALORIE PRODUCTION AND PRICE PER MILLION CALORIES

Table V gives the index numbers of calorie production during this period, the average of the three years 1936/9 being taken as a base.

TABLE V

Index of Calorie Production and Price per Million Calories

	Index of calorie production	Price per 1,000,000 calories	Price per 1,000,000 calories				
			Wheat	Potatoes and sugar beet	Meat (all kinds)	Milk	Eggs
		Shillings	*Shillings*	*Shillings*	*Shillings*	*Shillings*	*Shillings*
1936/9 ..	100·0	321	115	98	481	332	1,457
1939/40 ..	103·7	374	123	100	558	383	2,007
1940/1 ..	107·7	474					
1941/2 ..	117·1	474					
1942/3 ..	141·2	446					
1943/4 ..	160·5	416	127	196	871	645	3,123
1944/5 ..	145·8	452	139	202	867	667	3,144
1945/6 ..	139·6	497					
1946/7	139·5	525					
1947/8 ..	119·6	656					
1948/9 ..	147·3	627	163	266	1,288	822	4,008
1949/50 ..	145·0	709	165	263	1,345	884	4,250

Equivalent price	*per gal.*	*per doz.*
1936/9 ..	1/0¼	1/4½
1939/40 ..	1/2¼	1/11½
1943/4 ..	1/11¾	3/-
1944/5 ..	2/0¾	3/-
1948/9 ..	2/6½	3/9½
1949/50 ..	2/9	4/-

It will be seen that, as already pointed out, the increase in home food production during the first two years of the war was quite small, but during the next three years it was very rapid, reaching a maximum of 60·5 per cent. above pre-war in 1943/4. Thereafter it fell to only 19·6 per cent. in 1947/8, partly because 1947 was a year of poor crop yields, and then rose again to about 46 per cent. above pre-war in 1948/9 and 1949/50.

Table V also shows the price which the farmer received for the yearly ration of one million calories per average person. This was about £16 in pre-war years, rose to about £24 in 1941/2, fell to about £21 in 1943/4 and then rose steadily to about £35 in 1949/50. These figures are based upon the total calorie production, as computed in Tables A to L in the appendix, divided into the money values, given in the official statistics of the products for which calories have been calculated. It must be emphasized that they represent prices received by the farmer and must not be confused with the prices paid by the consumer.

Similar calculations for the principal individual products—wheat, potatoes and sugar-beet, meat, milk and eggs—give some startling results, but confirm what is generally accepted: that the larger the proportion of crop products in the diet the cheaper it is

likely to be. The justification for the inclusion of animal products in the diet is, of course, that they have a profound effect upon its quality and palatability. It is true to say that as a measure of nutritive value—in the broadest sense of that term—the calorie can be more effectively, and less misleadingly, applied to a mixed diet than to an individual food, such as eggs, apples or tomatoes.

So far this paper has been solely concerned with "agricultural holdings" over 1 acre in size (¼ acre in Northern Ireland) and with the acreage of "crops and grass" but this definition of the problem does not take into account all aspects of it, and a brief reference must now be made to these broader aspects.

Non-Farm Production

In a complete appraisal of home food production, it is necessary to include the output of fruit, potatoes and other vegetables from gardens and allotments, of pigs, poultry and eggs from "domestic" pig and poultry keepers and of any other land outside the official definition of "agricultural holding". According to the official statistics, the average yearly production of pig meat from such sources was about 28,000 tons and of eggs about 121,000 tons. These products not only made a welcome addition to the quality of the diet, but also enabled about 271,000 additional persons to be fed each year. The corresponding figure in pre-war years was about 186,000 persons. In the smaller country towns and villages, the contribution of "domestic" fruit, potatoes and other vegetables to the diet must be quite appreciable but no official statistics are available under this head for the country as a whole.

Output from Rough Grazings

In the above computations of the acreage required to feed an average person for a year, it will be noticed that no allowance has been made for the 17 million acres of rough grazings on hills and moorlands. The chief products from this land are, of course, store lambs, cast ewes (and wool), as well as a limited number of store cattle; but since the calories derived from mutton and lamb comprise only between 2 and 3 per cent. of the total calorie production and since a considerable proportion of the mutton and lamb has its origin on the "crops and grass" and not on the rough grazings, it is probably fair to say that not more than about 1 per cent. of the total calorie production can be attributed to the rough grazings. In other words, the omission of rough grazings has no appreciable effect on the acreage required per person.

Imports of Feedingstuffs, Seeds and Livestock

In the official calculations of the *net* monetary output from U.K. soils, a deduction is made from the *gross* output for the value of imported animal foodstuffs, livestock and seeds, on the ground that these products represent part of the agricultural output of other countries. For example, if store cattle are imported from Eire and fattened in the U.K., it is clear that, in a strict accounting sense, only the *increase* in the calorie value of these cattle which took place in the U.K. can properly be credited to U.K. calorie production.

During the period in question, imports of store cattle averaged about 400,000 head annually, but it is extremely difficult to put a calorie value on such cattle, since both the killing-out percentage and the edible value of the meat are highly uncertain. In any case, it would form a very small proportion of the total calorie production in the U.K.—less than 1 per cent.

As regards feedingstuffs and seeds, it is true, of course, that without such imports either the output of milk, meat and eggs or the acreage devoted to food crops would have

to be reduced. On the other hand, in so far as the animal foodstuffs are the by-products from the processing of cereals, oil seeds and nuts, it might be contended that the importation of these commodities is necessary in the interests of other sections of industry and that it is not much, if at all, influenced by the requirements of agriculture.

At any rate, the bulk of these by-products—mill offals, oil cakes and meals etc.—have no direct value as human food, nor is it possible, without making a good many highly debatable assumptions, to calculate the calorie value of the milk, meat and eggs, which can be attributed to their consumption by livestock. Further, imported feedingstuffs are characterized by their comparatively high protein content and it would not be easy to obtain equivalent amounts of protein merely by increasing the acreage of the ordinary feed crops. Hence, a substantial falling off in the amount of protein fed to livestock might result in a reduction of the livestock output. However, a full discussion of the relationship between imported feedingstuffs and the efficiency of livestock feeding, as well as between the importation of seeds and the level of crop yields, is far outside the scope of this paper.

There is indeed a danger that the bearing of imports of livestock, feedingstuffs and seeds upon the calorie production of British agriculture may be given an importance which it does not deserve.

In the first place, the heavy reduction in the imports of animal foodstuffs was only one of the important changes which took place in agriculture during the war and post-war years—the imports of "oil cakes and meals" fell from 1,648,000 tons in 1936/8 to only 622,000 tons in 1946 and then rose to 1,098,000 tons in 1949. For example, the number of "horses for agricultural purposes" declined from 724,170 in 1939 to only 454,439 in 1949 and since the average farm horse, in regular work, consumes yearly the produce of about four acres of land, this change resulted in *over one million acres* of "crops and grass" being set free for the production of food crops, or of milk, meat and eggs. In other words, during this period a gradually decreasing proportion of the land was devoted to the creation of motive power which cannot be eaten by either man or beast. In place of the horse came the internal combustion engine in its various forms and the essential difference between the horse and the engine is that, whereas the former is bred on the land and fed off it, the latter is a product of another industry and is "fed" almost entirely on imported fuel. Hence, although in one sense agriculture during the war became more self-supporting in another it became much more dependent on other industries.

And, of course, there was a great expansion in the use of fertilizers, including lime, as indicated by an expenditure of £8,443,000 in 1938/9, £27,943,000 in 1945/6 and no less than £42,587,000 in 1949/50.

Secondly, it follows that the yearly calorie production during the war and post-war years was the result of a number of more or less conflicting changes in the pattern of British agriculture. The reduction in the imports of animal feedingstuffs had a depressing effect on the output, but this was more than balanced by the increased output due to the substitution of the machine for the horse, to the greater use of fertilizers and lime, to the use of improved varieties of crops, to the greater control over diseases, insect and fungoid pests and weeds, to better cultivations, more efficient management and so on. It would therefore be rather illogical to make some adjustment in the calorie production because of the reduction in the imports of animal foodstuffs unless adjustments were also made on account of the factors just mentioned.*

The real question at issue is: under what agricultural policy, under what national policy, can the number of persons which British agriculture can feed in a year be raised to its maximum, on the assumption, the validity of which will be questioned in some circles,

* In a paper read to the Agricultural Economics Society in July, 1953, H. T. Williams (Ministry of Agriculture) gave the following indices to illustrate the changes in some of the agricultural inputs for the period under consideration. (*continued on page 20*)

that it is in the national interests to reduce the imports of human foodstuffs to a minimum? Is it better to restrict the imports of animal feedingstuffs and livestock, be content with a lower output of human food and make up the difference by imports; or should the policy be to import large quantities of animal feedingstuffs and livestock in order to raise the home production of human food to the highest possible level; or should an intermediate policy be adopted? These are large and complicated questions which obviously lie outside the scope of this study.

Calorie Production per Man

The question is bound to be asked: what changes in the calorie production "per man" have there been during the period under review? In principle, this is a very simple question which can be answered by dividing the number of "men" engaged in agriculture each year into the calorie production for that year. The latter is now known, but how is the former to be determined? Perhaps the most authoritative recent computation of the number of "man-equivalents" engaged in agriculture during the period in question is that made by H. T. Williams.* The relevant data are brought together in Table VI.

Table VI

Indices of workers employed, Total Calorie Production and Calorie Production "per man"

	Man-equivalents employed (Williams)	Total calorie production (Table V)	Calorie production "per man"
1936/9	100	100·0	100
1939/40	99	103·7	105
1940/1	101	107·7	107
1941/2	103	117·1	114
1942/3	107	141·2	132
1943/4	108	160·5	149
1944/5	109	145·8	134
1945/6	107	139·6	130
1946/7	108	139·5	129
1947/8	108	119·6	111
1948/9	108	147·3	136
1949/50	105	145·0	138

(*continued from page 19*)

	Imported animal foodstuffs (tonnage)	Machinery depreciation (1945/6 prices)	Fuel (tonnage)	Fertilizers and lime (tonnage)			
				N (nitrogen)	P_2O_5 (phosphates)	K_2O (potash)	CaO (lime)
Pre-war ..	100	100	100	100	100	100	100
1939/40 ..	90	111	109	129	115	113	77
1940/1 ..	59	126	145	213	137	63	82
1941/2 ..	36	147	182	280	169	82	97
1942/3 ..	19	158	218	285	178	97	136
1943/4 ..	18	174	236	303	202	138	157
1944/5 ..	21	179	264	287	203	153	143
1945/6 ..	28	189	282	274	210	148	151
1946/7 ..	21	189	309	273	209	143	116
1947/8 ..	28	205	345	308	233	236	174
1948/9 ..	36	205	373	308	246	261	204
1949/50 ..	46	221	409	375	270	312	242

* op. cit.

It will be seen that, on this basis, the calorie production "per man" employed, increased to a maximum of nearly 50 per cent. above pre-war, fell to as low as 11 per cent. and then rose to about 37 per cent. in the last two years. It would, however, be wrong to conclude that this increased calorie production per man was due entirely, or even mainly, to the greater physical efforts of the workers. For one thing, as already shown, not only were the workers much better equipped with machinery of all kinds—witness the four-fold increase in the quantity of fuel consumed between 1939/40 and 1949/50—but also much larger quantities of fertilizers and lime were used; for another, a fair comparison of production per man in the pre-war and in the war and post-war years would have to take into account the number of men that were employed in the construction and repair of the additional machinery that was in use on the farms. In short, although the data given in Table VI are interesting so far as they go, they do not tell the whole story and care must be taken not to draw the wrong conclusions from them.

Some Comparative Yearly Results

Finally, it may be helpful to bring together the results for selected years, namely:

(1) 1936/9—representing the pre-war situation.
(2) 1940/1—a year in which the food production campaign was not yet in full swing.
(3) 1943/4—the year of maximum calorie production.
(4) 1947/8—the year in which calorie production fell sharply and heavily.
(5) 1948/50—years marked by a revival in livestock production all along the line.

This is done in Table VII.

It will be seen that, apart from substantial increases in the acreages under barley and oats, the differences between the pre-war period and the second year of the war (1940/1) were comparatively small. Calorie production in that year was capable of feeding only a little over a million more people than in the pre-war years. The peak of production was reached in 1943/4, partly owing to an exceptionally high acreage of wheat and to very high potato and sugar beet acreages—the three most prolific calorie producers—and partly to a high wheat yield per acre. In that year, no less than 71 per cent. of the total calorie production was derived from crops and only 29 per cent. from livestock. The number of persons fed from the agricultural land of the U.K. increased to 26¼ million—60 per cent. above the pre-war number.

In 1947/8, the wheat acreage slumped heavily and crop yields per acre were exceptionally poor. Hence, despite a considerable improvement in the output of milk and eggs, the total calorie production fell to only 20 per cent. above pre-war, against 60 per cent. in 1943/4. Comparison of the results for 1947/8 and 1949/50 shows that the percentage of calories from crops does not give a reliable indication of the total calorie production.

In 1948/9 and 1949/50, the acreage of wheat was not very different from what it was in 1947/8 but the yield per acre was 40 per cent. higher. Yields per acre of potatoes and sugar beet were also substantially better on considerably higher acreages, while the output of milk, eggs and meat was also considerably higher. Hence, although the total calorie production did not reach the very high level of 1943/4 it was about 22 per cent. higher than in 1947/8.

One important general conclusion from this and other tables must be that *maximum calorie production depends to a very large extent upon a combination of large acreages and high yields per acre for wheat, potatoes and sugar beet.*

Special Aspects

In the course of this paper several aspects of food production in the U.K. have been dismissed as being outside the scope of this study, but there are two special aspects to which brief reference may now be made.

TABLE VII

Comparison of Results for Selected Years

	1936/9	1940/1	1943/4	1947/8	1948/9	1949/50
ACREAGE (1,000's)						
Wheat	1,856	1,809	3,464	2,163	2,279	1,963
Barley	929	1,339	1,786	2,060	2,083	2,060
Oats	2,403	3,400	3,680	3,308	3,335	3,252
Potatoes	723	832	1,391	1,330	1,548	1,308
Sugar beet	335	329	417	395	413	421
AVERAGE YIELD PER ACRE						
Wheat (cwt.)	17·7	18·1	19·9	15·4	20·7	22·5
Barley (cwt.)	16·4	16·5	18·4	15·7	19·5	20·7
Oats (cwt.)	16·2	17·0	16·7	15·2	17·8	18·4
Potatoes (tons)	6·8	7·7	7·1	5·8	7·6	6·9
Sugar beet (tons)	8·2	9·7	9·1	7·6	10·5	9·5
LIVESTOCK NUMBERS (millions)						
Cattle (dairy)	3·8	4·0	4·3	4·4	4·5	4·6
Total	8·8	9·1	9·3	9·6	9·8	10·2
Sheep (ewes)	—	12·9	10·2	9·0	9·2	9·7
Total	26·4	26·3	20·4	16·7	18·2	19·5
Pigs (sows)	0·5	0·5	0·2	0·2	0·3	0·3
Total	4·4	4·1	1·8	1·6	2·2	2·8
Poultry (adult fowls)	32·0	33·9	23·4	31·5	34·4	39·6
Total	78·2	71·2	50·7	70·0	85·4	95·5
TOTAL PRODUCTION						
Milk (million gallons)	1,563	1,446	1,580	1,704	1,909	2,011
Eggs (thousand tons)	304	291	160	223	279	344
Meat, all kinds (thousand tons)	1,413	1,359	919	845	983	1,142
CALORIE PRODUCTION						
Per acre crops and grass (1,000's)	541	583	867	647	796	784
Index	100·0	107·7	160·5	119·6	147·3	145·0
Percentage calories from						
Cereals	17·6	21·6	42·5	27·3	30·2	27·9
Potatoes and sugar beet	24·2	26·5	26·2	29·4	30·2	28·2
Fruit and vegetables	2·9	3·1	2·5	3·6	2·8	2·6
Total crops	44·7	51·2	71·2	60·3	63·2	58·7
Milk and eggs	31·5	27·4	19·4	28·5	26·0	28·1
Meat	23·8	21·4	9·4	11·2	10·8	13·2
Total livestock	55·3	48·8	28·8	39·7	36·8	41·3
Acreage required per person	1·85	1·72	1·15	1·54	1·26	1·28
Persons fed per 100 acres	54	58	87	65	80	78
No. of persons fed (1,000's)	16,687	17,828	26,285	19,579	24,224	23,845
Index of calorie production per man-equivalent	100	107	149	111	136	138

First, it may be asked: what is the relative importance, in terms of calorie production during the period under consideration, of (*a*) changes in the acreages of crops and numbers of livestock and, (*b*) changes in the output per unit of crops and livestock—cwt. per acre of wheat, gallons of milk per cow and so on? For example, what would the calorie production per acre have been in 1943/4 if the outputs per unit of crops and livestock had been

the same as in 1936/7 to 1938/9, and what would it have been if the acreages of crops and numbers of livestock had been as they were in pre-war years?

The essential difficulty in trying to answer such questions arises from the assumption that there was no connection between changes in acreages and livestock numbers and changes in the outputs per unit. In fact, the changes in the pattern of U.K. agriculture during the war and post-war years were extremely diverse and exceedingly complex. Who can say what the average yield per cow would have been in 1943/4 if imported cakes and meals had been available in almost unlimited supplies at economic prices or what the tillage acreage would have been if there had not been a substantial increase in the supply of tractors and other mechanical equipment? Further, there is little doubt that the same general conditions—the national emergency, guaranteed markets and prices, governmental direction and control and so on—the same general conditions which were largely responsible for the changes in the crop acreages and livestock numbers were also partly responsible for the changes in the yields per unit of both crops and livestock—seasonal conditions, of course, played a dominant part. In the main, this study has been concerned with factual results for each of the years 1939/40 to 1949/50 and it seems better not to complicate the issue still further by trying to compute purely hypothetical results.

Secondly, it may be asked: what is the optimum combination of crops and livestock which would enable any given level of calorie production to be reached? Reference to Tables III and IV shows that the same calorie output can be obtained in very different ways. Compare, for example, the data for 1944/5 and 1949/50 which are summarized in Table VIII.

TABLE VIII

Comparison of the Results for 1944/5 and 1949/50

	1944/5	1949/50
Calorie production per acre	788,177	784,035
Acreage required to feed one person	1·27	1·28
Percentage calories from:		
Cereals	37·2	27·9
Potatoes and sugar beet	27·6	28·2
Fruit and vegetables	2·9	2·6
Total crops	67·7	58·7
Milk and eggs	21·7	28·1
Meat	10·6	13·2
Total livestock	32·3	41·3
Tillage land—million acres	14·6	12·7
Dairy cattle—millions	4·4	4·6
Other cattle—millions	5·1	5·6
Sheep—millions	20·1	19·5
Pigs—millions	1·9	2·8
Poultry—millions	55·1	95·5
Yield per acre:		
wheat—cwt.	19·5	22·5
potatoes—tons	6·4	6·9
sugar beet—tons	7·7	9·5
Average milk yield per cows—gallons	485	581
Acreage of:		
wheat—1,000's	3,220	1,963
potatoes—1,000's	1,417	1,308
sugar beet—1000's	431	421

A glance over this table shows numerous changes in the make-up of U.K. farming during these two years: in 1944/5 nearly 68 per cent. of the calorie production was derived from crops, whereas in 1949/50, partly owing to the reduction in the wheat acreage and the increase in the number of cows and in the average milk yield per cow, the corresponding figure in 1949/50 was only about 59 per cent. In favour of the 1949/50 pattern, it may be urged that the "quality" of the calorie output was substantially higher than it was in 1944/5; on the other hand, as indicated in Table V, the cost of a million calories with the 1949/50 content is likely to be appreciably higher than it would be with the 1944/5 content.

Perhaps the only general conclusion that can be drawn on this count is that the same calorie production can be obtained from widely different combinations of crops and livestock, but the optimum combination must have some relation to (*a*) the "quality" of the calorie production and (*b*) the cost per million calories. From the point of view of quantity and cheapness, there is little doubt that the acreages under wheat, potatoes and sugar beet are of supreme importance but this is not the same as saying that, in the present circumstances, a calorie production of which as much as 50 per cent. is derived from livestock is not to be preferred in the interest of national health and fitness.

It is obvious that a full discussion of this aspect of food production would, sooner or later, lead to the question: what would be a sound agricultural policy for this country? but that question also does not lie within the scope of this study.

Summary

1. In 1923 Middleton calculated that in 1909/13 it required about three acres of crops and grass to feed an average person in the U.K. for a year; in 1926 Hall gave a figure of 2 to 2½ acres and in 1942 Sir John Russell put the required area at 1·7 acres. This paper is concerned with the acreage of crops and grass required to feed one person for a year in the U.K. during the period 1939/40 to 1949/50, the three years 1936/7 to 1938/9 being taken as a pre-war standard.
2. On the basis of an allowance of one million calories per average person per annum, it is shown that in 1939/40 the required acreage was 1·78, in 1943/4 it was only 1·15, it increased abruptly to 1·54 in 1947/8 and was about 1·27 in 1948/9 and 1949/50.
3. The percentage composition of the yearly calorie production varied considerably. Crops contributed 47 per cent. in 1939/40, rising to 71 per cent. in 1943/4 and falling to 59 per cent. in 1949/50 while the contribution of cereals ranged from 18 per cent. in 1939/40 to 42 per cent. in 1943/4 and 28 per cent. in 1949/50. Meat of all kinds contributed only 9 per cent. in 1943/4 against 23 per cent. in 1939/40 and 13 per cent. in 1949/50.
4. It is shown that the yearly variations in the calorie output are due partly to variations in the acreages of crops and numbers of livestock and partly to variations in the average yield per acre of crops and per head of livestock.
5. The total number of persons fed off U.K. crops and grass was about 17·3 million in 1939/40, 26·3 million in 1943/4, 19·6 million in 1947/8 and 23·8 million in 1949/50, compared with about 16·7 million in pre-war years.
6. The cost per million calories was substantially higher in animal than in crop products.
7. The calorie production per man engaged in agriculture in the U.K. in 1943/4 was about 49 per cent. higher than in pre-war years, the corresponding figures for 1947/8 and 1949/50 being 11 and 38 per cent. respectively; but it is pointed out that this increase was largely due to the greater employment of machinery, to heavier applications of fertilizers and to all-round improvement in managerial efficiency.

8. It is suggested that the optimum combination of crops and livestock for food production purposes must have regard not only to the quantity of calories produced but also to the quality of the calorie diet and its price.

General References

1. *Food Production in War*, by T. H. Middleton.
2. *Nutritive Values of War-time Foods*. Medical Research Council War Memorandum, No. 14 (reprinted, 1953).
3. Ministry of Food Bulletin, No. 720, September 19th, 1953.
4. "Diets and Dietetics" by Samson Wright, M.D., *Encyclopaedia Brittanica*, 14th edition, Vol. 7.
5. *The Efficiency of Farm Animals in the Conversion of Feedingstuffs to Food for Man*, by I. Leitch and W. Godden, Commonwealth Bureau of Animal Nutrition, Technical Communication, No. 14.
6. *Analyses and Energy Values of Foods*, by R. H. A. Plimmer (1921).

APPENDIX

TABLE A

Calorie Output in U.K.—1936/9

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	1,856	17·7	730 (841)	1,790,544	10·8
Barley	929	16·4	521 (531)	840,269	5·0
Oats	2,403	16·2	118 (426)	285,466	1·7
Rye	16	12·5	2	5,376	—
Mixed corn	97	15·9	8	19,712	0·1
	5,301	—	1,379	2,941,367	17·6
		tons			
Potatoes	723	6·8	3,191	2,501,744	15·0
Sugar beet	335	8·2	2,741	1,534,960	9·2
	1,058		5,932	4,036,704	24·2
Fruit	307		444	149,184	0·9
Vegetables	278		1,971	331,128	2·0
	585		2,415	480,312	2·9
Total Crops				7,458,383	44·7
Milk (million gallons)			1,563	4,829,670	28·9
Eggs			304	429,005	2·6
				5,258,675	31·5
Beef			554	1,551,200	9·3
Veal			24	32,256	0·2
Mutton and lamb			195	611,520	3·7
Pig meat			416	1,490,944	8·9
Offal—all			105	164,640	1·0
Poultry meat			79	77,862	0·5
Rabbits and game			40	41,216	0·2
			1,413	3,969,638	23·8
Total livestock				9,228,313	55·3
Grand total				16,686,696	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,838,000
Less		
Wheat, Barley } not for human food	125,000	
Barley } not for human food	12,000	
Oats	380,000	
Beans—stockfeed	13,000	
Hay	350,000	
Flax	23,000	
Linseed	—	
Hops	18,000	
Mustard seed	27,000	
Flowers and nursery stock	24,000	
		972,000
NET ACREAGE		30,866,000

Calories per acre: 540,617

Acreage per person: 1·85

Persons fed per 100 acres: 54·1

TABLE B

Calorie Output in U.K.—1939/40

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	1,766	18·6	681	1,742,052	10·1
Barley	1,013	17·6	595 (604)	959,616	5·5
Oats	2,427	16·5	141 (423)	341,107	2·0
Rye	14	13·7	2	5,376	—
Mixed corn	85	17·4	7	17,248	0·1
	5,305		1,426	3,065,399	17·7
		tons			
Potatoes	704	7·4	3,224	2,527,616	14·6
Sugar beet	344	10·3	3,529	1,976,240	11·4
	1,048		6,753	4,503,856	26·0
Fruit	301		810	272,160	1·6
Vegetables	291		2,003	336,504	1·9
	592		2,813	608,664	3·5
Total crops				8,177,919	47·2
Milk (million gallons)			1,550	4,789,500	27·7
Eggs			308	434,650	2·5
				5,224,150	30·2
Beef			551	1,542,800	8·9
Veal			23	30,912	0·2
Mutton and lamb			200	627,200	3·6
Pig meat			402	1,440,768	8·3
Offal—all			103	161,504	1·0
Poultry meat			73	71,949	0·4
Rabbits and game			45	46,368	0·2
			1,397	3,921,501	22·6
Total livestock				9,145,651	52·8
Grand total				17,323,570	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,679,000	Calories per acre: 560,760
Less			
Barley, Oats } not for human food	10,000		
Beans—stockfeed	342,000		Acreage per person: 1·78
Hay	14,000		
Flax	330,000		
Linseed	23,000		Persons fed per 100 acres 56·1
Hops	—		
Mustard seed	19,000		
Flowers and nursery stock	23,000		
	25,000		
		786,000	
NET ACREAGE		30,893,000	

TABLE C.

Calorie Output in U.K.—1940/1

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	1,809	18·1	892	2,281,807	12·8
Barley	1,339	16·5	690 (700)	1,112,832	6·3
Oats	3,400	17·0	175 (448)	423,360	2·4
Rye	17	12·6	5	13,440	—
Mixed corn	262	17·4	9	22,176	0·1
	6,827		1,771	3,853,615	21·6
		tons			
Potatoes	832	7·7	3,766	2,952,544	16·6
Sugar beet	329	9·7	3,176	1,778,560	9·9
	1,161		6,942	4,731,104	26·5
Fruit	301		593	199,248	1·1
Vegetables	304		2,102	353,136	2·0
	605		2,695	552,384	3·1
Total crops				9,137,103	51·2
Milk (million gallons)			1,446	4,468,140	25·1
Eggs			291	410,659	2·3
				4,878,799	27·4
Beef			532	1,489,600	8·4
Veal			28	37,632	0·2
Mutton and lamb			228	715,008	4·0
Pig meat			362	1,297,408	7·3
Offal—all			111	174,048	0·9
Poultry meat			68	67,021	0·4
Rabbits and game			30	30,912	0·2
			1,359	3,811,629	21·4
Total livestock				8,690,428	48·8
Grand total				17,827,531	100·0

*Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,430,000
Less		
Barley, Oats not for human food	12,000	
	321,000	
Beans—stockfeed	7,000	
Hay	360,000	
Flax	65,000	
Linseed	—	
Hops	19,000	
Mustard seed	24,000	
Flowers and nursery stock	18,000	
		826,000
NET ACREAGE		30,604,000

Calories per acre: 582,523

Acreage per person: 1·72

Persons fed per 100 acres 58·3

TABLE D

Calorie Output in U.K.—1941/2

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*Millions*	%
Wheat	2,265	17·8	1,461	4,352,611	22·5
Barley	1,475	15·5	771 (783)	1,243,469	6·5
Oats	3,951	16·4	325 (594)	786,240	4·1
Rye	41	13·2	15	40,320	0·2
Mixed corn	544	16·1	10	24,640	0·1
	8,276		2,582	6,447,280	33·4
		tons			
Potatoes	1,123	7·1	4,333	3,397,072	17·6
Sugar beet	351	9·3	3,226	1,806,560	9·3
	1,474		7,559	5,203,632	26·9
Fruit	310		329	110,544	0·5
Vegetables	375		2,399	403,032	2·1
	685		2,728	513,576	2·6
Total crops				12,164,488	62·9
Milk (million gallons)			1,417	4,378,530	22·7
Eggs			218	307,642	1·6
				4,686,172	24·3
Beef			399	1,117,200	5·8
Veal			25	33,600	0·2
Mutton and lamb			173	542,528	2·8
Pig meat			159	569,856	2·9
Offal—all			82	128,576	0·7
Poultry meat			59	58,150	0·3
Rabbits and game			20	20,608	0·1
			917	2,470,518	12·8
Total livestock				7,156,690	37·1
Grand total				19,321,178	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,353,000	Calories per acre: 633,274
Less			
Barley, Oats } not for human food	15,500		
	328,500		Acreage per person: 1·58
Hay	320,000		
Flax	128,000		
Linseed	3,000		Persons fed per 100 acres: 63·3
Hops	18,000		
Mustard seed	17,000		
Flowers and nursery stock	13,000		
		843,000	
NET ACREAGE		30,510,000	

TABLE E

Calorie Output in U.K.—1942/3

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	2,516	20·4	1,905	5,675,376	24·5
Barley	1,528	18·9	1,142 (1,159)	1,841,818	7·9
Oats	4,133	17·2	513 (805)	1,241,050	5·4
Rye	59	15·4	34	91,392	0·4
Mixed corn	546	17·0	10	24,640	0·1
	8,782		3,604	8,874,276	38·3
		tons			
Potatoes	1,304	7·2	4,934	3,868,256	16·7
Sugar beet	425	9·3	3,924	2,197,440	9·5
	1,729		8,858	6,065,696	26·2
Fruit	302		762	256,032	1·1
Vegetables	422		2,716	456,288	2·0
	724		3,478	712,320	3·1
Total crops				15,652,292	67·6
Milk (million gallons)			1,522	4,702,980	20·3
Eggs			165	232,848	0·9
				4,935,828	21·2
Beef			451	1,262,800	5·5
Veal			31	41,664	0·2
Mutton and lamb			174	545,664	2·4
Pig meat			144	516,096	2·2
Offal—all			91	142,688	0·6
Poultry meat			55	54,208	0·2
Rabbits and game			15	15,456	0·1
			961	2,578,576	11·2
Total livestock				7,514,404	32·4
Grand total				23,166,696	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,204,000
Less		
Barley, Oats not for human food	18,000	
	339,000	
Hay	312,000	
Flax	118,000	
Linseed	6,000	
Hops	18,000	
Mustard seed	22,000	
Flowers and nursery stock	12,000	
		845,000
NET ACREAGE		30,359,000

Calories per acre: 763,091

Acreage per person: 1·31

Persons fed per 100 acres: 76·3

TABLE F

Calorie Output in U.K.—1943/4

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	3,464	19·9	2,816	8,389,427	31·9
Barley	1,786	18·4	1,006 (1,045)	1,622,477	6·2
Oats	3,680	16·7	386 (562)	933,811	3·5
Rye	129	14·8	79	212,352	0·8
Mixed corn	501	15·7	5	12,320	0·1
	9,560		4,292	11,170,387	42·5
		tons			
Potatoes	1,391	7·1	6,094	4,777,696	18·2
Sugar beet	417	9·1	3,760	2,105,600	8·0
	1,808		9,854	6,883,296	26·2
Fruit	301		641	215,376	0·8
Vegetables	423		2,647	444,696	1·7
	724		3,288	660,072	2·5
Total crops				18,713,755	71·2
Milk (million gallons)			1,580	4,882,200	18·6
Eggs			160	225,792	0·8
				5,107,992	19·4
Beef			449	1,257,200	4·8
Veal			31	41,664	0·2
Mutton and lamb			154	482,944	1·8
Pig meat			134	480,256	1·8
Offal—all			89	139,552	0·5
Poultry meat			47	46,323	0·2
Rabbits and game			15	15,456	0·1
			919	2,463,395	9·4
Total livestock				7,571,387	28·8
Grand total				26,285,142	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,058,000	Calories per acre: 867,325
Less			
Barley, Oats not for human food	42,400		
	217,600		Acreage per person: 1·15
Hay	300,000		
Flax	145,000		
Linseed	3,000		Persons fed per 100 acres: 86·7
Hops	19,000		
Mustard seed	16,000		
Flowers and nursery stock	9,000		
		752,000	
NET ACREAGE		30,306,000	

TABLE G

Calorie Output in U.K.—1944/5

Product	Average	Yield per acre	Sold for Human Food	Total Calorie Value	Percentage
	1000's	*cwt.*	*1000 tons**	*Millions*	%
Wheat	3,220	19·5	2,266	6,436,165	26·9
Barley	1,973	17·8	983 (1,035)	1,585,382	6·6
Oats	3,656	16·2	278 (449)	672,538	2·8
Rye	120	14·7	67	180,096	0·8
Mixed corn	424	16·5	5	12,320	0·1
	9,393		3,599	8,886,501	37·2
		tons			
Potatoes	1,417	6·4	6,061	4,751,824	19·9
Sugar beet	431	7·7	3,267	1,829,520	7·7
	1,848		9,328	6,581,344	27·6
Fruit	298		628	211,008	0·9
Vegetables	504		2,860	480,480	2·0
	802		3,488	691,488	2·9
Total crops				16,159,333	67·7
Milk (Million gallons)			1,594	4,925,460	20·7
Eggs			169	238,493	1·0
				5,163,953	21·7
Beef			471	1,318,800	5·5
Veal			33	44,352	0·2
Mutton and Lamb			140	439,040	1·8
Pig meat			145	519,680	2·2
Offal—all			89	139,552	0·6
Poultry meat			50	49,280	0·2
Rabbits and game			15	15,456	0·1
			943	2,526,160	10·6
Total Livestock				7,690,113	32·3
Grand Total				23,849,446	100·0

* Figures in brackets represent total farm sales.

Total Acreage: crops and grass		31,008,000	Calories per acre: 788,177
Less			
Barley, Oats } not for human food	58,400		
	211,600		Acreage per person: 1·27
Hay	250,000		
Flax	184,000		
Linseed	3,000		Persons fed per ·100 acres: 78·8
Hops	20,000		
Mustard seed	13,000		
Flowers and Nursery stock	9,000		
		749,000	
NET ACREAGE		30,259,000	

TABLE H

Calorie Output in U.K.—1945/6

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	2,274	19·1	1,425	4,095,336	18·0
Barley	2,215	19·0	1,062 (1,260)	1,712,794	7·5
Oats	3,753	17·3	391 (609)	945,907	4·2
Rye	80	14·7	44	118,272	0·5
Mixed corn	443	16·8	5	12,320	0·1
	8,765		2,927	6,884,629	30·3
		tons			
Potatoes	1,397	7·0	6,309	4,946,256	21·8
Sugar beet	417	9·4	3,886	2,176,160	9·6
	1,814		10,195	7,122,416	31·4
Fruit	295		489	164,304	0·7
Vegetables	512		2,890	485,520	2·2
	807		3,379	649,824	2·9
Total crops				14,656,869	64·6
Milk (million gallons)			1,654	5,110,860	22·5
Eggs			195	275,184	1·2
				5,386,044	23·7
Beef			504	1,411,200	6·2
Veal			32	43,008	0·2
Mutton and lamb			135	423,360	1·8
Pig meat			161	577,024	2·5
Offal—all			91	142,688	0·6
Poultry meat			57	56,179	0·3
Rabbits and game			15	15,456	0·1
			995	2,668,915	11·7
Total livestock				8,054,959	35·4
Grand total				22,711,828	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,023,000
Less		
Barley, Oats not for human food	208,400	
	252,600	
Hay	290,000	
Flax	124,000	
Linseed	5,000	
Hops	20,000	
Mustard seed	18,000	
Flowers and nursery stock	11,000	
		929,000
NET ACREAGE		30,094,000

Calories per acre: 754,696

Acreage per person: 1·33

Persons fed per 100 acres: 75·5

TABLE I

Calorie Output in U.K.—1946/7

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	2,062	19·1	1,385	4,225,469	18·5
Barley	2,211	17·8	914 (1,024)	1,474,099	6·5
Oats	3,567	16·3	280 (403)	677,376	2·9
Rye	55	14·2	28	75,264	0·3
Mixed corn	458	15·3	5	12,320	0·1
	8,353		2,612	6,464,528	28·3
		tons			
Potatoes	1,423	7·1	6,623	5,192,432	22·7
Sugar beet	436	10·5	4,522	2,532,320	11·1
	1,859		11,145	7,724,752	33·8
Fruit	311		670	225,120	1·0
Vegetables	559		2,711	455,448	2·0
	870		3,381	680,568	3·0
Total crops				14,869,848	65·1
Milk (million gallons)			1,665	5,144,850	22·5
Eggs			198	279,418	1·3
				5,424,268	23·8
Beef			503	1,408,400	6·2
Veal			34	45,696	0·2
Mutton and lamb			141	442,176	1·9
Pig meat			118	422,912	1·8
Offal—all			90	141,120	0·6
Poultry meat			57	56,179	0·3
Rabbits and game			15	15,456	0·1
			958	2,531,939	11·1
Total livestock				7,956,207	34·9
Grand total				22,826,055	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,010,000
Less		
Barley, Oats — not for human food	123,600	
	150,400	
Beans—stockfeed	1,500	
Hay	350,500	
Flax	53,000	
Linseed	2,000	
Hops	21,000	
Mustard seed	25,000	
Flowers and nursery stock	14,000	
		741,000
NET ACREAGE		30,269,000

Calories per acre: 754,107

Acreage per person: 1·33

Persons fed per 100 acres: 75·4

TABLE J

Calorie Output in U.K.—1947/8

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	2,163	15·4	1,055	3,143,056	16·0
Barley	2,060	15·7	1,062 (1,168)	1,712,794	8·7
Oats	3,308	15·2	188 (251)	454,810	2·3
Rye	36	12·5	12	32,256	0·2
Mixed corn	498	15·5	5	12,320	0·1
	8,065		2,322	5,355,236	27·3
		tons			
Potatoes	1,330	5·8	5,225	4,096,400	20·9
Sugar beet	395	7·6	2,960	1,657,600	8·5
	1,725		8,185	5,754,000	29·4
Fruit	313		811	272,496	1·4
Vegetables	553		2,535	425,880	2·2
	866		3,346	698,376	3·6
Total crops				11,807,612	60·3
Milk (million gallons)			1,704	5,265,360	26·9
Eggs			223	314,698	1·6
				5,580,058	28·5
Beef			451	1,262,800	6·4
Veal			27	36,288	0·2
Mutton and lamb			112	351,232	1·8
Pig meat			93	333,312	1·7
Offal—all			82	128,576	0·7
Poultry meat			65	64,064	0·3
Rabbits and game			15	15,456	0·1
			845	2,191,728	11·2
Total livestock				7,771,786	39·7
Grand total				19,579,398	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,022,000
Less		
Barley, Oats not for human food	135,000	
	83,000	
Beans—stockfeed	2,000	
Hay	330,000	
Flax	31,000	
Linseed	8,000	
Hops	22,000	
Mustard for seed	36,000	
Flowers and nursery stock	16,000	
Flooded land not cropped	87,000	
		750,000
NET ACREAGE		30,272,000

Calories per acre: 646,783

Acreage per person: 1·54

Persons fed per 100 acres: 64·7

TABLE K

Calorie Output in U.K.—1948/9

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	2,279	20·7	1,614	4,808,429	19·8
Barley	2,083	19·5	1,063 (1,150)	1,714,406	7·1
Oats	3,335	17·8	282 (382)	682,214	2·8
Rye	61	15·5	35	94,080	0·4
Mixed corn	598	17·3	5	12,320	0·1
	8,356		2,999	7,311,449	30·2
		tons			
Potatoes	1,548	7·6	6,263	4,910,192	20·2
Sugar beet	413	10·5	4,319	2,418,640	10·0
	1,961		10,582	7,328,832	30·2
Fruit	314		680	228,480	0·9
Vegetables	580		2,689	451,752	1·9
	894		3,369	680,232	2·8
Total crops				15,320,513	63·2
Milk (million gallons)			1,909	5,898,810	24·4
Eggs			279	393,725	1·6
				6,292,535	26·0
Beef			473	1,324,400	5·4
Veal			27	36,288	0·2
Mutton and lamb			130	407,680	1·7
Pig meat			170	609,280	2·5
Offal—all			90	141,120	0·6
Poultry meat			78	76,877	0·3
Rabbits and game			15	15,456	0·1
			983	2,611,101	10·8
Total livestock				8,903,636	36·8
Grand total				24,224,149	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,062,000	Calories per acre: 796,270
Less			
Barley, Oats not for human food	89,000 + 112,000		Acreage per person 1·26
Beans—stockfeed	1,000		
Hay	300,000		Persons fed per 100 acres: 79·6
Flax	35,000		
Linseed	45,000		
Hops	23,000		
Mustard seed	17,000		
Flowers and nursery stock	18,000		
		640,000	
NET ACREAGE		30,422,000	

TABLE L

Calorie Output in U.K.—1949/50

Product	Acreage	Yield per acre	Sold for human food	Total calorie value	Percentage
	1,000's	*cwt.*	*1,000 tons**	*millions*	%
Wheat	1,963	22·5	1,462	4,355,590	18·2
Barley	2,060	20·7	954 (1,087)	1,538,612	6·4
Oats	3,252	18·4	264 (375)	638,669	2·7
Rye	65	16·8	42	112,896	0·5
Mixed corn	680	19·0	5	12,320	0·1
	8,020		2,727	6,658,087	27·9
		tons			
Potatoes	1,308	6·9	5,756	4,512,704	18·9
Sugar beet	421	9·5	3,962	2,218,720	9·3
	1,729		9,718	6,731,424	28·2
Fruit	324		763	256,368	1·1
Vegetables	533		2,157	362,376	1·5
	857		2,920	618,744	2·6
Total crops				14,008,255	58·7
Milk (million gallons)			2,011	6,213,990	26·1
Eggs			344	485,453	2·0
				6,699,443	28·1
Beef			498	1,394,400	5·8
Veal			26	34,944	0·2
Mutton and lamb			142	445,312	1·9
Pig meat			284	1,017,856	4·3
Offal—all			94	147,392	0·6
Poultry meat			83	81,805	0·3
Rabbits and game			15	15,456	0·1
			1,142	3,137,165	13·2
Total livestock				9,836,608	41·3
Grand total				23,844,863	100·0

* Figures in brackets represent total farm sales.

Total acreage: crops and grass		31,056,000
Less		
Barley, Oats not for human food	128,500	
	120,500	
Beans—stockfeed	1,250	
Hay	267,250	
Flax	46,000	
Linseed	22,500	
Hops	22,000	
Mustard seed	15,000	
Flowers and nursery stock	20,000	
		643,000
NET ACREAGE		30,413,000

Calories per acre: 784,035

Acreage per person: 1·28

Persons fed per 100 acres: 78·4

TABLE M

Utilization of Land in U.K. (million acres): 1936/8 and 1939 to 1949

Crop year	Arable land			Permanent grass	Total crops and grass	Rough grazings
	Tillage	Temp. grass	Total*			
1936/8	8·9	4·2	13·1	18·7	31·8	16·5
1939	8·8	4·1	12·9	18·8	31·7	16·5
1940	10·4	3·9	14·3	17·1	31·4	16·6
1941	12·7	3·6	16·3	15·1	31·4	17·0
1942	13·6	3·9	17·5	13·7	31·2	17·0
1943	14·5	4·2	18·7	12·4	31·1	17·1
1944	14·6	4·7	19·3	11·7	31·0	17·0
1945	13·9	5·3	19·2	11·8	31·0	17·3
1946	13·3	5·7	19·0	12·0	31·0	17·3
1947	12·9	5·6	18·5	12·4	31·0†	17·2
1948	13·2	5·5	18·7	12·4	31·1	17·2
1949	12·7	5·7	18·4	12·7	31·1	17·2

* Includes bare fallow.
† Includes 0·1 million acres temporarily out of use through flooding.

TABLE N

Livestock Population of Agricultural Holdings in U.K. at June censuses (million head): 1936/8 and 1939 to 1949

Year	Cattle			Sheep			Pigs			Poultry		
	Dairy	Other	Total	Ewes	Other	Total	Sows	Other	Total	Adult fowls	Other	Total
1936/8 ..	3·8	5·0	8·8	—	—	26·4	0·5	3·9	4·4	32·0	46·2	78·2
1939	3·9	5·0	8·9	13·2	13·7	26·9	0·5	3·9	4·4	31·0	43·4	74·4
1940	4·0	5·1	9·1	12·9	13·4	26·3	0·5	3·6	4·1	33·9	37·3	71·2
1941	4·0	4·9	8·9	11·1	11·2	22·3	0·3	2·3	2·6	35·7	26·4	62·1
1942	4·2	4·9	9·1	10·6	10·9	21·5	0·3	1·9	2·2	27·1	30·7	57·8
1943	4·3	5·0	9·3	10·2	10·2	20·4	0·2	1·6	1·8	23·4	27·3	50·7
1944	4·4	5·1	9·5	10·2	9·9	20·1	0·3	1·6	1·9	23·3	31·8	55·1
1945	4·3	5·3	9·6	10·3	9·9	20·2	0·3	1·9	2·2	25·3	36·8	62·1
1946	4·4	5·2	9·6	10·4	10·0	20·4	0·2	1·8	2·0	28·4	38·7	67·1
1947	4·4	5·2	9·6	9·0	7·7	16·7	0·2	1·4	1·6	31·5	38·5	70·0
1948	4·5	5·3	9·8	9·2	9·0	18·2	0·3	1·9	2·2	34·4	51·0	85·4
1949	4·6	5·6	10·2	9·7	9·8	19·5	0·3	2·5	2·8	39·6	55·9	95·5

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